

WHAT IS CLAIMED IS:

1. A dehydrogenation catalyst which comprises:

an organometallic pincer complex bonded to an inorganic oxide support, said organometallic pincer complex possessing catalytic activity for the dehydrogenation of alkyl groups.

2. The dehydrogenation catalyst of claim 1 wherein the pincer complex includes at least one element selected from Group VIII or Group IB of the Periodic Table of the elements, and at least one element selected from Group VA of the Periodic Table of the elements in each of first and second molecular arm portions, the Group VIII or Group IB element being bonded to each of the Group VA elements.

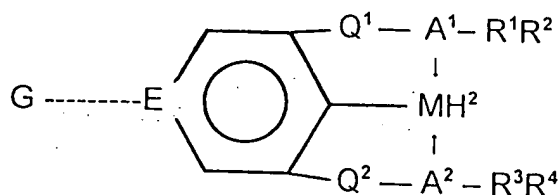
3. The dehydrogenation catalyst of claim 2 wherein the first and second molecular arm portions are each bonded to a molecular core portion, the Group VIII or Group IB element being bonded directly or indirectly to the molecular core portion.

4. The dehydrogenation catalyst of claim 3 wherein the molecular core portion comprises an aromatic ring.

5. The dehydrogenation catalyst of claim 4 wherein the first molecular arm portion comprises a  $Q^1-A^1-R^1R^2$  group and the second molecular arm portion comprises a  $Q^2-A^2-R^3R^4$  group, wherein  $A^1$  and  $A^2$  are the same or different and are each

independently selected from phosphorus, nitrogen, arsenic and antimony,  $Q^1$  and  $Q^2$  are the same or different and are each independently selected from  $-CH_2-$ ,  $-CH_2CH_2-$ , and  $-CH=CH-$ , and  $R^1$ ,  $R^2$ ,  $R^3$  and  $R^4$  are the same or different and are each independently selected from alkyl, alkenyl, cycloalkyl and aryl having from 1 to 10 carbon atoms, or  $R^1$  and  $R^2$  together and/or  $R^3$  and  $R^4$  together form a ring structure having from about 4 to about 10 carbon atoms.

6. The dehydrogenation catalyst of claim 1 wherein the pincer complex has the formula:



wherein  $A^1$  and  $A^2$  can be the same or different and are each independently phosphorus, nitrogen, arsenic or antimony,  $E$  is carbon, silicon or germanium,  $G$  is optional and is selected from the group consisting of  $-OH$ ,  $-NH_2$ ,  $-SH$ ,  $-OR^5$ ,  $-R^5C=C$ ,  $-R^6OH$ ,  $-R^6NH_2$ ,  $-R^6COOH$ , or  $-R^6COOR^7$  wherein  $R^5$  is an alkyl group having from 1 to 10 carbon atoms,  $R^6$  is a substituted alkyl group with up to 5 carbon atoms, and  $R^7$  is an alkyl group having from about 1 to 10 carbon atoms,  $M$  is a Group VIII or Group IB metal,  $Q^1$  and  $Q^2$  can be the same or different and are each independently  $-CH_2-$ ,  $-CH_2CH_2-$ , and  $-CH=CH-$ , and  $R^1$ ,  $R^2$ ,  $R^3$  and  $R^4$  can be the same or different and are each independently selected from

alkyl, alkenyl, cycloalkyl and aryl having from 1 to 10 carbon atoms, or R<sup>1</sup> and R<sup>2</sup> together and/or R<sup>3</sup> and R<sup>4</sup> together form a ring structure having from about 4 to about 10 carbon atoms.

5           7. The dehydrogenation catalyst of claim 1 wherein the pincer complex has the formula  $\text{IrH}_2\{\text{C}_6\text{H}_2\text{G}(\text{CH}_2\text{PR}_2)_2-2,6\}$  wherein R is a tert-butyl or isopropyl group and G is -OH, -NH<sub>2</sub>, -SH, -OR<sup>5</sup>, -R<sup>5</sup>C=C, -R<sup>6</sup>OH, -R<sup>6</sup>NH<sub>2</sub>, -R<sup>6</sup>COOH, or -R<sup>6</sup>COOR<sup>7</sup> wherein R<sup>5</sup> is an alkyl group having from 1 to 10 carbon atoms, R<sup>6</sup> is a substituted alkyl group with up to 5 carbon atoms, and R<sup>7</sup> is an alkyl group having from about 1 to 10 carbon atoms.

10           8 The dehydrogenation catalyst of claim 1 wherein the pincer complex is bonded to the inorganic oxide support by means of a bridging group.

15           9. The dehydrogenation catalyst of claim 8 wherein the bridging group is derived from compounds containing a triethoxysilyl group and isocyanate group, or compounds containing a triethoxysilyl group and a halogenated alkane.

20           10. The dehydrogenation catalyst of claim 8 wherein the inorganic oxide support is a mesoporous inorganic oxide.

          11. The dehydrogenation catalyst of claim 1 wherein the inorganic oxide support is a porous inorganic oxide having at least 97 volume percent mesopores based on

micropores and mesopores of the inorganic oxide, and having an X-ray diffraction peak at between 0.3 and 3 degree in  $2\theta$ , having surface area of 400 - 1100 m<sup>2</sup>/g, and having total pore volume of about 0.3-2.2 cm<sup>3</sup>/g, said mesopores being randomly interconnected.

5                    12. A method for dehydrogenating an organic compound comprising the steps of:

a) providing a reaction zone containing a dehydrogenation catalyst including an organometallic pincer complex bonded to an inorganic oxide support, said organometallic pincer complex possessing catalytic activity for alkyl group dehydrogenation;

10                    b) contacting an organic compound possessing at least one alkyl group with said catalyst under dehydrogenation conditions to produce a dehydrogenated organic compound wherein hydrogen is separated from the dehydrogenated compound within the reaction zone.

15                    13. The method of claim 12 wherein the inorganic oxide support is a mesoporous inorganic oxide.

14. The method of claim 12 wherein the organic compound is ethylbenzene and the dehydrogenated compound is styrene.

20                    15. The method of claim 12 wherein the organic compound is an alkane or mixture of alkanes and the dehydrogenated compound is an alkene or mixture of alkenes.

16. The method of claim 12 wherein the organic compound is a cycloalkane or mixture of cycloalkanes and the dehydrogenated compound is a cycloalkene or mixture of cycloalkenes.

5            17. The method of claim 12 wherein the organic compound is methylcyclohexane and the product is toluene.

18. The method of claim 12 wherein the reaction temperature ranges from about 100°C to about 150°C.

10            19. The method of claim 12 further including the step of adding at least one polymerization inhibitor to the styrene.

20. The method of claim 13 wherein the mesoporous inorganic oxide support is a  
15            porous inorganic oxide having at least 97 volume percent mesopores based on micropores and mesopores of the inorganic oxide, and having an X-ray diffraction peak at between 0.3 and 3 degree in  $2\theta$ , having surface area of 400 - 1100 m<sup>2</sup>/g, and having total pore volume of about 0.3-2.2 cm<sup>3</sup>/g, said mesopores being randomly interconnected.

20            21. The method of claim 12 wherein the reaction zone is within a catalytic distillation system.

22. A method for dehydrogenating an organic compound comprising the steps of:

a) providing a reaction zone containing a dehydrogenation catalyst including an organometallic pincer complex bonded to a mesoporous inorganic oxide support, said organometallic pincer complex possessing catalytic activity for the dehydrogenation of alkyl groups;

b) contacting an organic compound possessing at least one alkyl group with said catalyst under dehydrogenation conditions to produce a dehydrogenated organic compound wherein the produced hydrogen is removed by reaction with a scavenger molecule.

23. The method of claim 22 wherein the scavenger molecule is an alkene, the alkene being converted by reaction with hydrogen to a corresponding alkane.